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High Resolution Measurements of Nonlinear Internal Waves and Mixing on the Washington Continental Shelf

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LONG-TERM GOALS

We are interested in the general problems of internal waves and ocean mixing. Knowledge of these is important for advancing the performance of operational and climate models, as well as for understanding local problems such as pollutant dispersal and biological productivity. In the specific case of nonlinear internal waves (NLIWs), the currents and displacements of the waves are strong enough to impact surface and under- sea operations. More generally, most of the ocean's physical and acoustic environments are severely impacted by internal waves. The pilot research described here will begin to improve our knowledge and predictive ability of NLIWs and their impacts on the Washington shelf. Additionally, it will form the foundation for better understanding of NLIW propagation and mixing on continental shelves worldwide.

OBJECTIVES

- Measure the time-evolution of wave structure by tracking as many waves as possible from generation to eventual dissipation.
- Quantify dissipation and mixing associated with the waves and identify the processes leading to wave dissipation, using our Modular Microstructure Profiler (MMP).
- Identify wave generation sites and evolution using a combination of SAR satellite imagery, Shallow Water Integrated Mapping System (SWIMS) and shipboard acoustics (Biosonics).

APPROACH

Observations from a real-time mooring that we maintain on the Washington continental shelf indicate an extremely energetic field of nonlinear internal waves (NLIW) propagating onshore. As a fraction of the water depth, their amplitude is among the largest in the world. The waves propagate through a strongly time-variable sheared coastal jet current, and appear to be generated as remote internal tides shoal onto the shelf break. In this project we will use our Shallow Water Integrated Mapping System (SWIMS) and Modular Microstructure Profiler (MMP) instruments to directly measure their spatial structure and mixing, in order to 1) better understand the propagation and dissipation of extremely strongly nonlinear internal waves in sheared currents and 2) characterize their effects on the acoustic, physical and biological environment of the region.

WORK COMPLETED

We obtained two ship days on *R/V Thomas G. Thompson* from the University of Washington last April to conduct pilot wave-tracking measurements with SWIMS and Biosonics. Measurements were successful. Chris Jackson obtained a Synthetic Aperture Radar (image) to assist in interpretation of these waves. We are continuing to work with Chris on historical SAR imagery and to develop collection plans for our cruise next summer.

In the next few weeks we will be testing MMP from our local work boat, the R/V Jack Robertson.

Analysis of the first fall of mooring data indicates that the waves are most prominent in July-September, disappearing rapidly as the stratification deepens and weakens. Based on this new information, we rescheduled our cruise (formerly scheduled on Oceanus Oct 20, 2012) to next summer to maximize our chances of strong signals.

RESULTS

Because our cruise is next summer, we have no scientific results to date.

IMPACT/APPLICATIONS

The Washington waves are extremely strong, but completely uncharacterized. An assessment of them will allow determination of a) their possible impact on navigation, b) their possible effect in mixing and setting local watermass properties; c) the effect of their turbulence and transport on the local ecosystem. Additionally, a general understanding of waves in sheared currents will benefit a variety of problems.

TRANSITIONS

RELATED PROJECTS

This project would not have been possible without funds from a related award to transition SWIMS and MMP to my group from Mike Gregg's.

REFERENCES

PUBLICATIONS